LISTING OF THE CLAIMS:

This listing of claims will replace all prior versions, and listings, of claims in the application:

1. (Original) An apparatus for producing tractive effort, said apparatus comprising:

an energy source adapted for generating a high DC voltage;

a motor drive adapted for generating a motor voltage from said high DC voltage; and

a motor adapted for producing said tractive effort from said motor voltage,

said energy source comprising:

a heat engine adapted for generating mechanical power by burning a fuel;

an alternator adapted for generating an alternating voltage from said mechanical power;

a rectifier adapted for rectifying said alternating voltage and producing a low DC voltage;

an energy battery adapted for storing and delivering energy derived from said low DC voltage; and

a traction boost converter adapted for boosting said low DC voltage to produce said high DC voltage,

said motor drive comprising:

a power battery adapted for storing energy and delivering power at said high DC voltage; and

a traction converter adapted for generating said motor voltage from said high DC voltage during motoring operation and for generating said high DC voltage from said motor voltage during braking operation.

2. (Original) The apparatus of claim 1 wherein a ratio of the energy storage capacity of said motor drive to the power delivered by said energy source at said high DC voltage is between about 0.001 hours and about 60 hours.

3. (Original) The apparatus of claim 1 wherein a ratio of the energy storage capacity of said motor drive to the power delivered by said energy source at said high DC voltage is between about 0.5 hours and about 20 hours.

4. (Original) The apparatus of claim 1 further comprising a cranking inverter adapted for generating a cranking voltage from said low DC voltage during cranking operation of said alternator.

5. (Original) The apparatus of claim 4 wherein said cranking inverter is bi-directional and further comprises a charging boost converter adapted for boosting said alternating voltage.

6. (Original) The apparatus of claim 1 further comprising a utility converter adapted for converting said low DC voltage to a utility voltage.

7. (Original) The apparatus of claim 6 wherein said utility converter is further adapted for selectively converting said utility voltage to said low DC voltage.

8. (Original) The apparatus of claim 1 further comprising a utility converter adapted for converting said high DC voltage to a utility voltage.

9. (Original) The apparatus of claim 8 wherein said utility converter is further adapted for selectively converting said utility voltage to said high DC voltage.

10. (Original) The apparatus of claim 1 further comprising:

a cranking inverter adapted for selectively generating a cranking voltage or a utility voltage from said low DC voltage; and

a transfer switch adapted for selectively coupling said cranking voltage to said alternator or said utility voltage to a utility grid.

11. (Original) The apparatus of claim 10 wherein said cranking inverter is bi-directional and further comprises a charging boost converter adapted for boosting said alternating voltage.

12. (Original) The apparatus of claim 1 further comprising:

a cranking inverter adapted for selectively generating a cranking voltage or a utility voltage from said high DC voltage; and

a transfer switch adapted for selectively coupling said cranking voltage to said alternator or said utility voltage to a utility grid.

13. (Original) The apparatus of claim 1 wherein said energy source further comprises an ultracapacitor bank adapted for storing and delivering electrical energy, said traction boost converter being further adapted for controlling energy flows among said rectifier, said energy battery, and said ultracapacitor bank.

14. (Original) The apparatus of claim 13 further comprising a unidirectional coupler adapted for conducting current from said energy battery to said ultracapacitor bank.

15. (Original) The apparatus of claim 1 wherein said motor drive further comprises a power ultracapacitor adapted for storing and delivering energy derived from said high DC voltage.

16. (Original) The apparatus of claim 1 wherein said motor voltage is a DC voltage.

17. (Original) The apparatus of claim 1 wherein said alternator and said rectifier are further adapted for supplying power to auxiliary loads.

18. (Original) A method for producing tractive effort, said method comprising:

generating a high DC voltage;

generating a motor voltage from said high DC voltage; and

producing said tractive effort from said motor voltage,

said act of generating said high DC voltage comprising:

burning a fuel to generate mechanical power;

generating an alternating voltage from said mechanical power using an alternator;

rectifying said alternating voltage to produce a low DC voltage using a rectifier;

storing and delivering energy derived from said low DC voltage using an energy battery; and

boosting said low DC voltage to produce said high DC voltage,

said act of generating a motor voltage comprising:

storing energy and delivering power at said high DC voltage using a power battery; and

generating said motor voltage from said high DC voltage during motoring operation and generating said high DC voltage from said motor voltage during braking operation.

19. (Original) The method of claim 18 wherein a ratio of the energy storage capacity of said motor drive to the power delivered by said act of generating said high DC voltage is between about 0.001 hours and about 60 hours.

20. (Original) The method of claim 18 wherein a ratio of the energy storage capacity of said motor drive to the power delivered by said act of generating said high DC voltage is between about 0.5 hours and about 20 hours.

21. (Original) The method of claim 18 further comprising generating a cranking voltage from said low DC voltage during cranking operation of said alternator.

22. (Original) The method of claim 21 wherein said act of generating a cranking voltage further comprises boosting said alternating voltage.

23. (Original) The method of claim 18 further comprising converting said low DC voltage to a utility voltage.

24. (Original) The method of claim 23 further comprising selectively converting said utility voltage to said low DC voltage.

25. (Original) The method of claim 18 further comprising converting said high DC voltage to a utility voltage.

26. (Original) The method of claim 25 further comprising selectively converting said utility voltage to said high DC voltage.

27. (Original) The method of claim 18 further comprising:

selectively generating a cranking voltage or a utility voltage from said low DC voltage; and

selectively coupling said cranking voltage to said alternator or said utility voltage to a utility grid.

28. (Original) The method of claim 27 wherein said act of selectively generating a cranking voltage or a utility voltage further comprises boosting said alternating voltage.

29. (Original) The method of claim 18 further comprising:

selectively generating a cranking voltage or a utility voltage from said high DC voltage; and

selectively coupling said cranking voltage to said alternator or said utility voltage to a utility grid.

30. (Original) The method of claim 18 wherein said act of generating a high DC voltage further comprises:

storing and delivering electrical energy derived from said low DC voltage using an ultracapacitor bank; and

controlling energy flows among said rectifier, said energy battery, and said ultracapacitor bank.

31. (Original) The method of claim 30 further comprising conducting current unidirectionally from said energy battery to said ultracapacitor bank.

32. (Original) The method of claim 18 wherein said act of producing said tractive effort from said motor voltage further comprises storing and delivering energy derived from said high DC voltage using a power ultracapacitor.

33. (Original) The method of claim 18 wherein said motor voltage is a DC voltage.

34. (Original) The method of claim 18 wherein said act of generating said high DC voltage further comprises supplying power to auxiliary loads.

35. (Withdrawn) A locomotive for producing tractive effort, said locomotive comprising:

an energy source adapted for generating a high DC voltage;

a motor drive adapted for generating a motor voltage from said high DC voltage;

a motor adapted for producing a motor torque from said motor voltage; and

a wheel adapted for producing said tractive effort from said motor torque and applying said tractive effort to a rail,

said energy source comprising:

a heat engine adapted for generating mechanical power by burning a fuel;

an alternator adapted for generating an alternating voltage from said mechanical power;

a rectifier adapted for rectifying said alternating voltage and producing a low DC voltage;

an energy battery adapted for storing and delivering energy derived from said low DC voltage; and

a traction boost converter adapted for boosting said low DC voltage to produce said high DC voltage,

said motor drive comprising:

a power battery adapted for storing energy and delivering power at said high DC voltage; and

a traction converter adapted for generating said motor voltage from said high DC voltage during motoring operation and for generating said high DC voltage from said motor voltage during braking operation.

36. (Withdrawn) The locomotive of claim 35 wherein a ratio of the energy storage capacity of said motor drive to the power delivered by said energy source at said high DC voltage is between about 0.001 hours and about 60 hours.

37. (Withdrawn) The locomotive of claim 35 wherein a ratio of the energy storage capacity of said motor drive to the power delivered by said energy source at said high DC voltage is between about 0.5 hours and about 20 hours.

38. (Withdrawn) The locomotive of claim 35 further comprising a cranking inverter adapted for generating a cranking voltage from said low DC voltage during cranking operation of said alternator.

39. (Withdrawn) The locomotive of claim 38 wherein said cranking inverter is bi-directional and further comprises a charging boost converter adapted for boosting said alternating voltage.

40. (Withdrawn) The locomotive of claim 35 further comprising a utility converter adapted for converting said low DC voltage to a utility voltage.

41. (Withdrawn) The locomotive of claim 40 wherein said utility converter is further adapted for selectively converting said utility voltage to said low DC voltage.

42. (Withdrawn) The locomotive of claim 35 further comprising a utility converter adapted for converting said high DC voltage to a utility voltage.

43. (Withdrawn) The locomotive of claim 40 wherein said utility converter is further adapted for selectively converting said utility voltage to said high DC voltage.

44. (Withdrawn) The locomotive of claim 35 further comprising:

a cranking inverter adapted for selectively generating a cranking voltage or a utility voltage from said low DC voltage; and

a transfer switch adapted for selectively coupling said cranking voltage to said alternator or said utility voltage to a utility grid.

45. (Withdrawn) The locomotive of claim 44 wherein said cranking inverter is bi-directional and further comprises a charging boost converter adapted for boosting said alternating voltage.

46. (Withdrawn) The locomotive of claim 35 further comprising:

a cranking inverter adapted for selectively generating a cranking voltage or a utility voltage from said high DC voltage; and

a transfer switch adapted for selectively coupling said cranking voltage to said alternator or said utility voltage to a utility grid.

47. (Withdrawn) The locomotive of claim 35 wherein said energy source further comprises an ultracapacitor bank adapted for storing and delivering electrical energy, said traction boost converter being further adapted for controlling energy flows among said rectifier, said energy battery, and said ultracapacitor bank.

48. (Withdrawn) The locomotive of claim 47 further comprising a unidirectional coupler adapted for conducting current from said energy battery to said ultracapacitor bank.

49. (Withdrawn) The locomotive of claim 35 wherein said motor drive further comprises a power ultracapacitor adapted for storing and delivering energy derived from said high DC voltage.

50. (Withdrawn) The locomotive of claim 35 wherein said motor voltage is a DC voltage.

51. (Withdrawn) The locomotive of claim 35 wherein said alternator and said rectifier are further adapted for supplying power to auxiliary loads.

52. (Withdrawn) An off-highway vehicle for producing tractive effort, said off-highway vehicle comprising:

an energy source adapted for generating a high DC voltage;

a motor drive adapted for generating a motor voltage from said high DC voltage;

a motor adapted for producing a motor torque from said motor voltage;

a wheel adapted for producing a wheel torque from said motor torque; and

a tire adapted for producing said tractive effort from said wheel torque and applying said tractive effort to an off-highway surface,

said energy source comprising:

a heat engine adapted for generating mechanical power by burning a fuel;

an alternator adapted for generating an alternating voltage from said mechanical power;

a rectifier adapted for rectifying said alternating voltage and producing a low DC voltage;

an energy battery adapted for storing and delivering energy derived from said low DC voltage; and

a traction boost converter adapted for boosting said low DC voltage to produce said high DC voltage,

said motor drive comprising:

a power battery adapted for storing energy and delivering power at said high DC voltage; and

a traction converter adapted for generating said motor voltage from said high DC voltage during motoring operation and for generating said high DC voltage from said motor voltage during braking operation.

53. (Withdrawn) The off-highway vehicle of claim 52 wherein a ratio of the energy storage capacity of said motor drive to the power delivered by said energy source at said high DC voltage is between about 0.001 hours and about 60 hours.

54. (Withdrawn) The off-highway vehicle of claim 52 wherein a ratio of the energy storage capacity of said motor drive to the power delivered by said energy source at said high DC voltage is between about 0.5 hours and about 20 hours.

55. (Withdrawn) The off-highway vehicle of claim 52 further comprising a cranking inverter adapted for generating a cranking voltage from said low DC voltage during cranking operation of said alternator.

56. (Withdrawn) The off-highway vehicle of claim 55 wherein said cranking inverter is bi-directional and further comprises a charging boost converter adapted for boosting said alternating voltage.

57. (Withdrawn) The off-highway vehicle of claim 52 further comprising a utility converter adapted for converting said low DC voltage to a utility voltage.

58. (Withdrawn) The off-highway vehicle of claim 57 wherein said utility converter is further adapted for selectively converting said utility voltage to said low DC voltage.

59. (Withdrawn) The off-highway vehicle of claim 52 further comprising a utility converter adapted for converting said high DC voltage to a utility voltage.

60. (Withdrawn) The off-highway vehicle of claim 59 wherein said utility converter is further adapted for selectively converting said utility voltage to said high DC voltage.

61. (Withdrawn) The off-highway vehicle of claim 52 further comprising:

a cranking inverter adapted for selectively generating a cranking voltage or a utility voltage from said low DC voltage; and

a transfer switch adapted for selectively coupling said cranking voltage to said alternator or said utility voltage to a utility grid.

62. (Withdrawn) The off-highway vehicle of claim 61 wherein said cranking inverter is bi-directional and further comprises a charging boost converter adapted for boosting said alternating voltage.

63. (Withdrawn) The off-highway vehicle of claim 52 further comprising:

a cranking inverter adapted for selectively generating a cranking voltage or a utility voltage from said high DC voltage; and

a transfer switch adapted for selectively coupling said cranking voltage to said alternator or said utility voltage to a utility grid.

64. (Withdrawn) The off-highway vehicle of claim 52 wherein said energy source further comprises an ultracapacitor bank adapted for storing and delivering electrical energy, said traction boost converter being further adapted for controlling energy flows among said rectifier, said energy battery, and said ultracapacitor bank.

65. (Withdrawn) The off-highway vehicle of claim 64 further comprising a unidirectional coupler adapted for conducting current from said energy battery to said ultracapacitor bank.

66. (Withdrawn) The off-highway vehicle of claim 52 wherein said motor drive further comprises a power ultracapacitor adapted for storing and delivering energy derived from said high DC voltage.

67. (Withdrawn) The off-highway vehicle of claim 52 wherein said motor voltage is a DC voltage.

68. (Withdrawn) The off-highway vehicle of claim 52 wherein said alternator and said rectifier are further adapted for supplying power to auxiliary loads.

69. (New) An apparatus, comprising:

a rectifier electrically coupled to an alternating current energy source that is capable of rectifying alternating current and further capable of producing a first direct current having a first voltage;

a first battery electrically coupled to the rectifier and that is capable of receiving, storing, or receiving and storing the first direct current at the first voltage;

a boost converter electrically coupled to the first battery and that is capable of boosting the first voltage to a second voltage that is a relatively higher voltage than the first voltage;

a second battery electrically coupled to the boost converter, and that is capable of receiving the second voltage, and that is capable of receiving, storing, or receiving and storing the second voltage; and

a traction converter electrically coupled to the second battery and to a motor, and the traction converter is capable of receiving from the second battery the second voltage, and of supplying a motor voltage to the motor during a first mode of operation, and

the traction converter is further capable of receiving from the motor the motor voltage, and of supplying the second voltage to the second battery during a second mode of operation.

70. (New) An apparatus, comprising:

a first battery electrically coupled to an AC/DC rectifier and that is capable of receiving, storing, or receiving and storing a first direct current at a first voltage;

a boost converter electrically coupled to the first battery and that is capable of boosting the first voltage to a second voltage that is a relatively higher voltage than the first voltage; and

a second battery electrically coupled to the boost converter, and that is capable of receiving the second voltage, and that is capable of receiving, storing, or receiving and storing the second voltage.

71. (New) The apparatus as defined in claim 70, further comprising a an electric utility grid converter coupled to the first battery and that is capable of charging at least one of the first battery or the second battery from an electric utility grid.

72. (New) The apparatus as defined in claim 70, wherein the first battery has a higher energy density than the second battery.

73. (New) The apparatus as defined in claim 70, wherein the first direct current voltage is high voltage.

74. (New) The apparatus as defined in claim 70, wherein the first mode of operation is a motoring operation

75. (New) The apparatus as defined in claim 70, wherein the second mode of operation is a dynamic braking operation.

76. (New) The apparatus as defined in claim 70, further comprising a an electric utility voltage converter coupled to the first battery and that is capable of supplying electricity.